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Cianciullo

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[45] **Date of Patent: Aug. 9, 1988**

[54] **AUTOMATIC APPARATUS FOR STRAPPING ELONGATED SUPERPOSED BODIES**

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PCT Pub. Date: **Dec. 31, 1986**

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[51] **Int. Cl.**[4] **B21F 9/02**

[52] **U.S. Cl.** ..... **140/119**; 140/93 A; 140/57

[58] **Field of Search** ..... 140/53, 54, 57, 93 A, 140/93.6, 119

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Primary Examiner—Lowell A. Larson

Attorney, Agent, or Firm—Browdy and Neimark

[57] **ABSTRACT**

An automatic apparatus for strapping together a first and a second superposed elongated body (**1,2**) even in a nonangulated axial relationship, with particular reference to reinforcement for reinforcing concrete, essentially comprising a rotatable system of locking devices (**141**) capable of engaging respective ends of two wire-like elements, relatively stiff, previously proportioned and shaped, straddling over said first elongated body of under said second elongated body, side by side opposed edges of said second elongated body or said first elongated body, respectively, so that following the rotation around its own axis of said system of locking devices the ends of said wire-like elements are twisted together in pairs under said second elongated body or all together over the first elongated body, in order to perform the sought strapping.

17 Claims, 12 Drawing Sheets

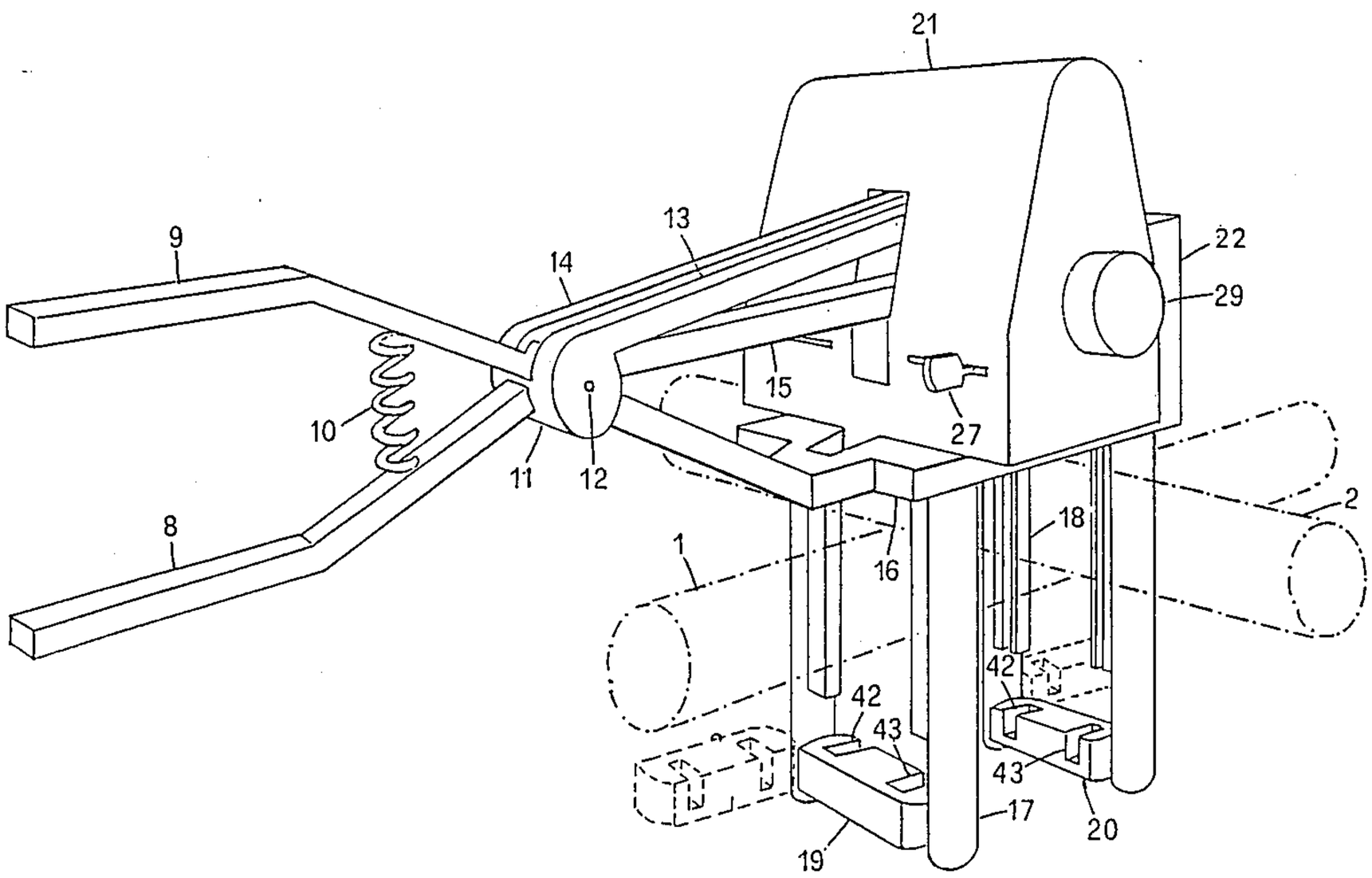


FIG.1

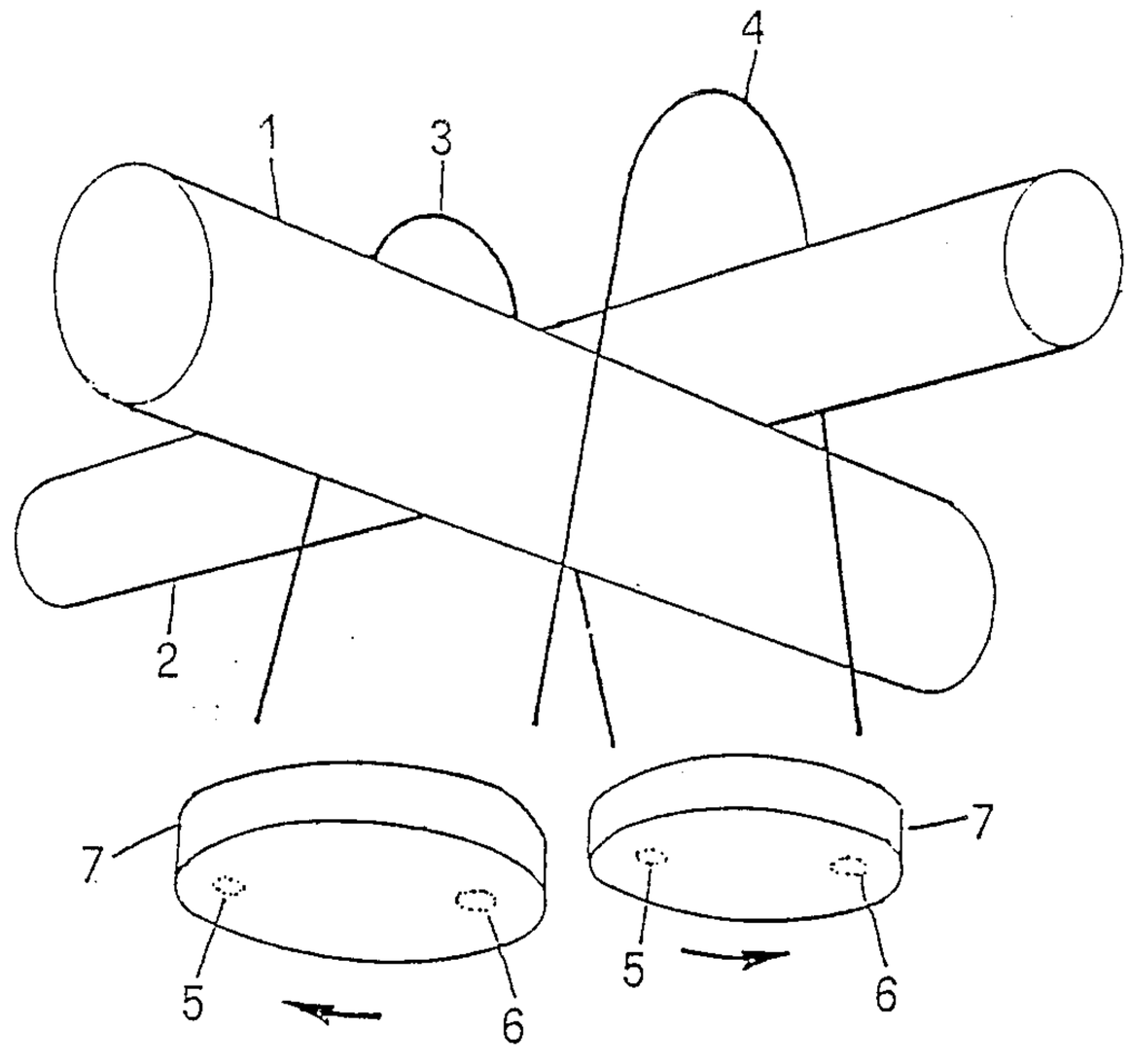
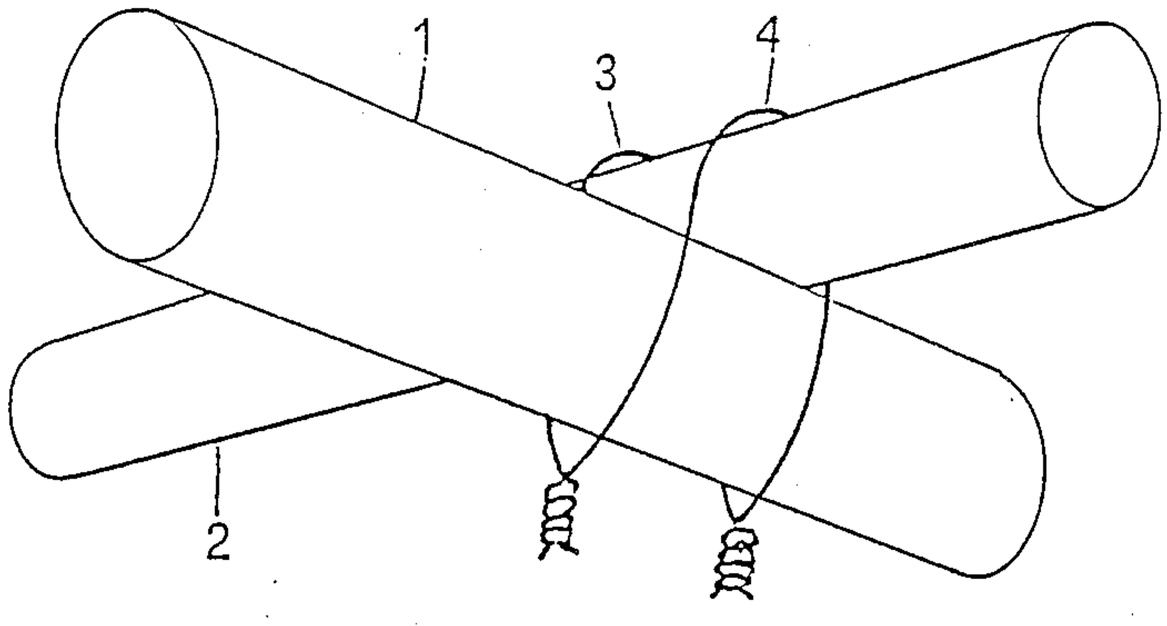


FIG.2



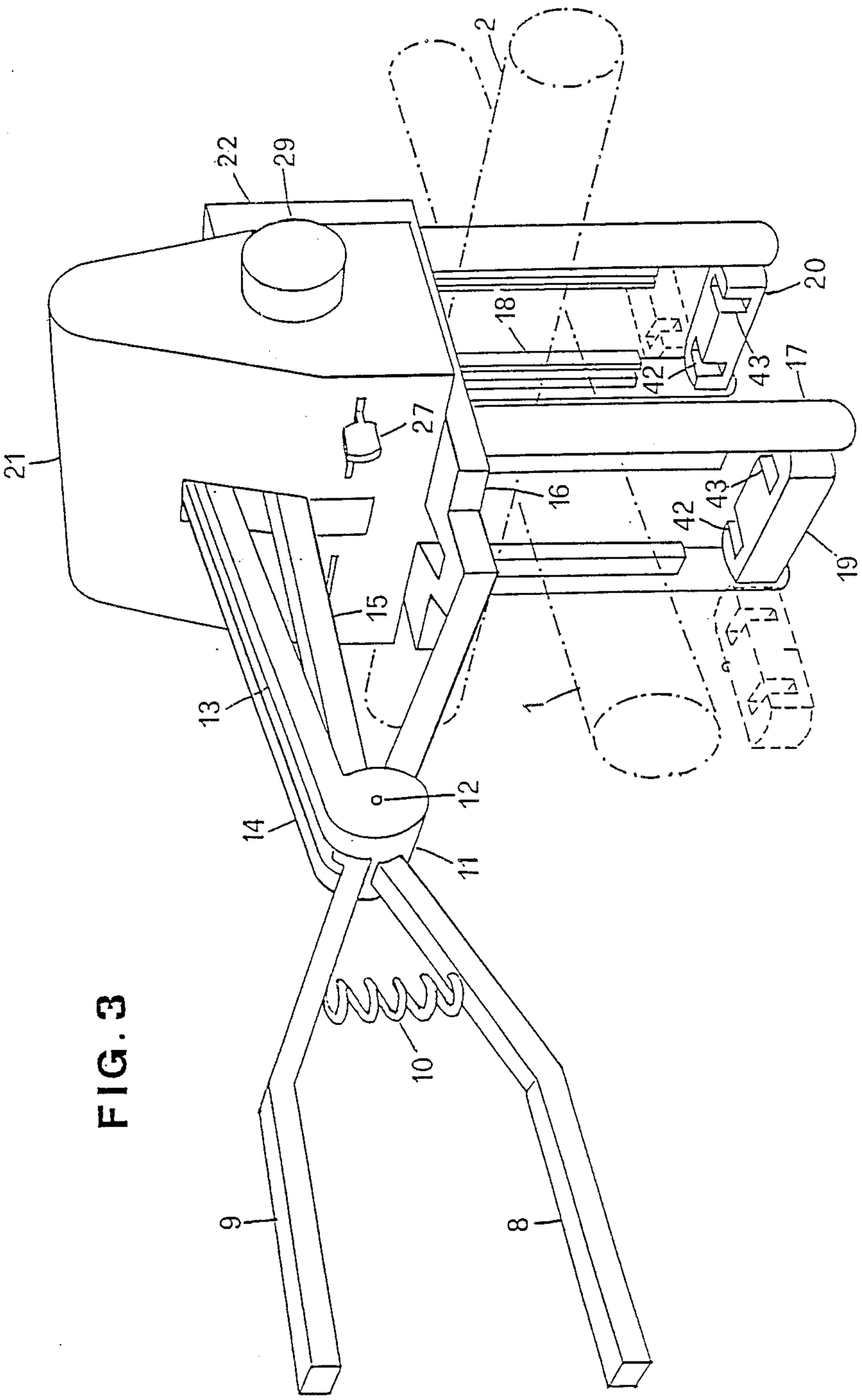


FIG. 3

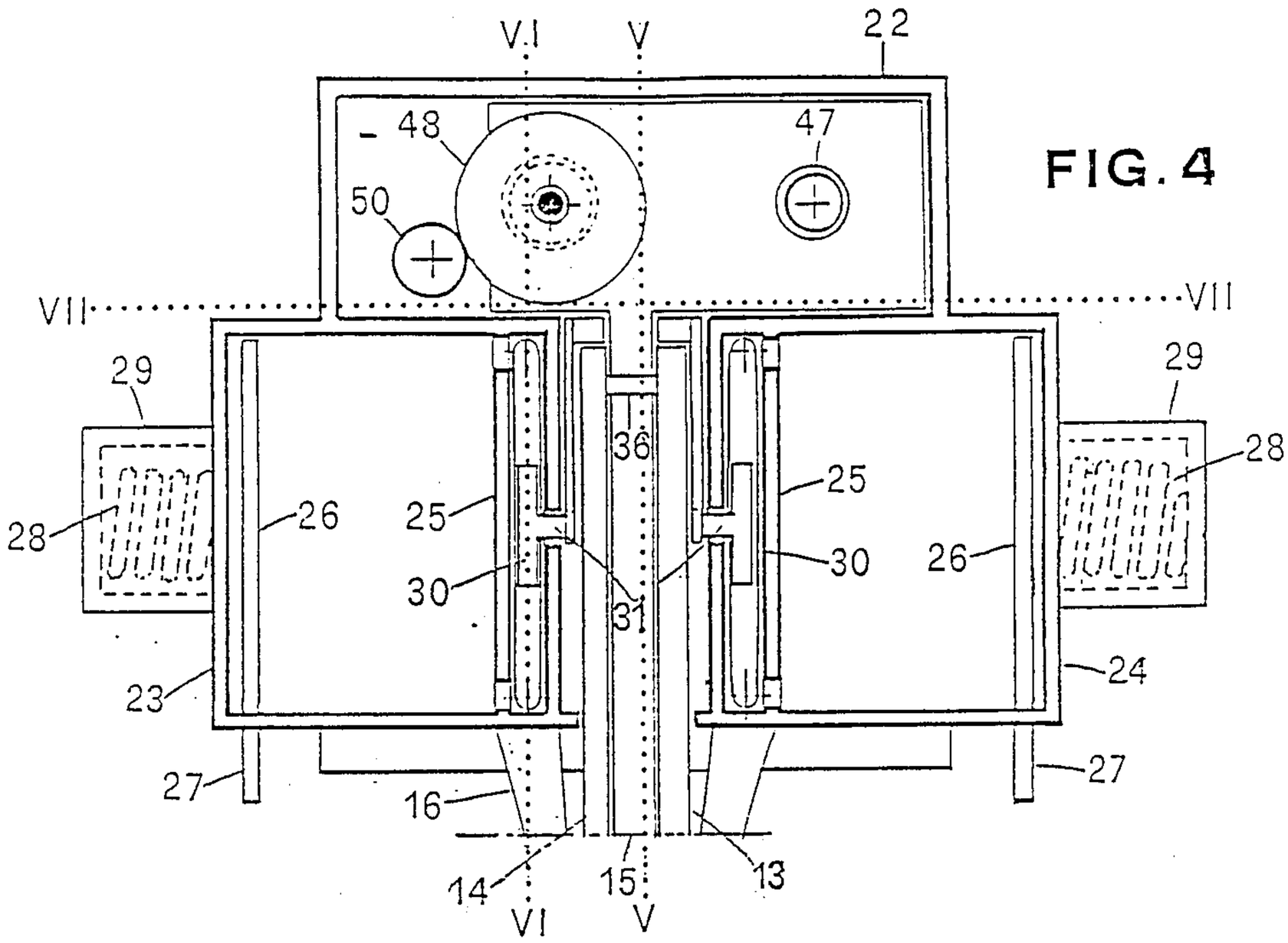

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FIG. 4

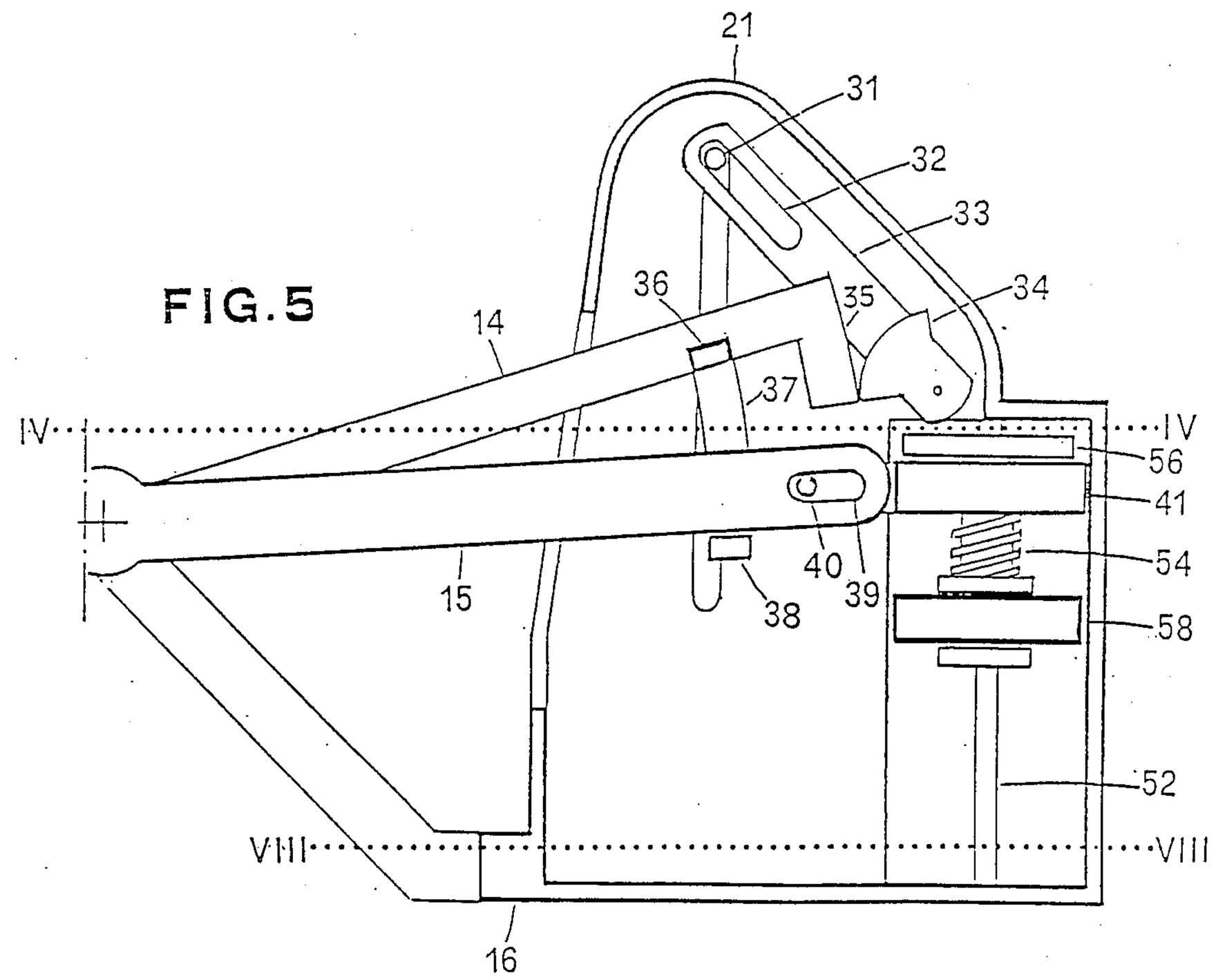
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FIG. 5

FIG. 6

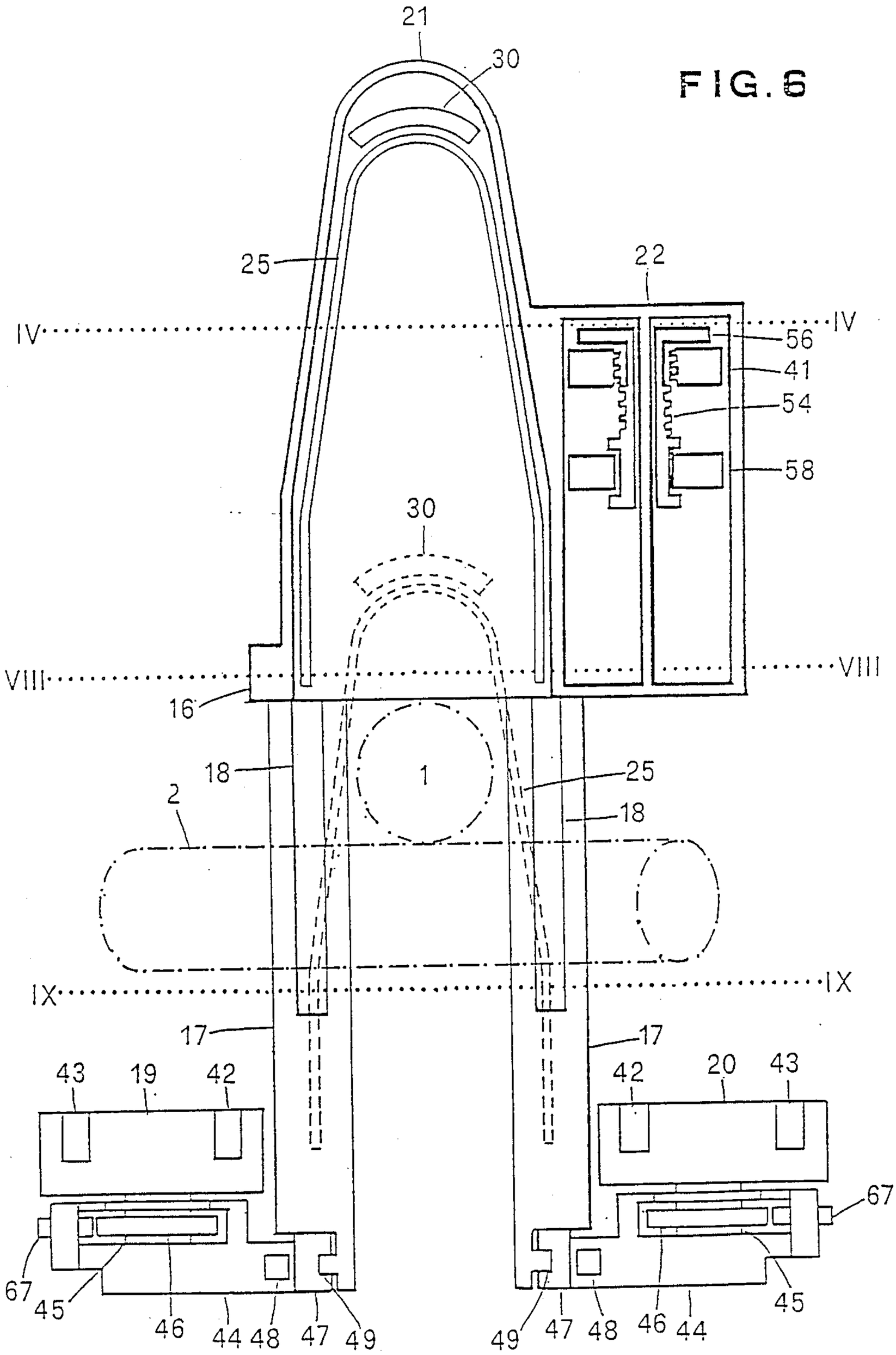
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FIG. 7

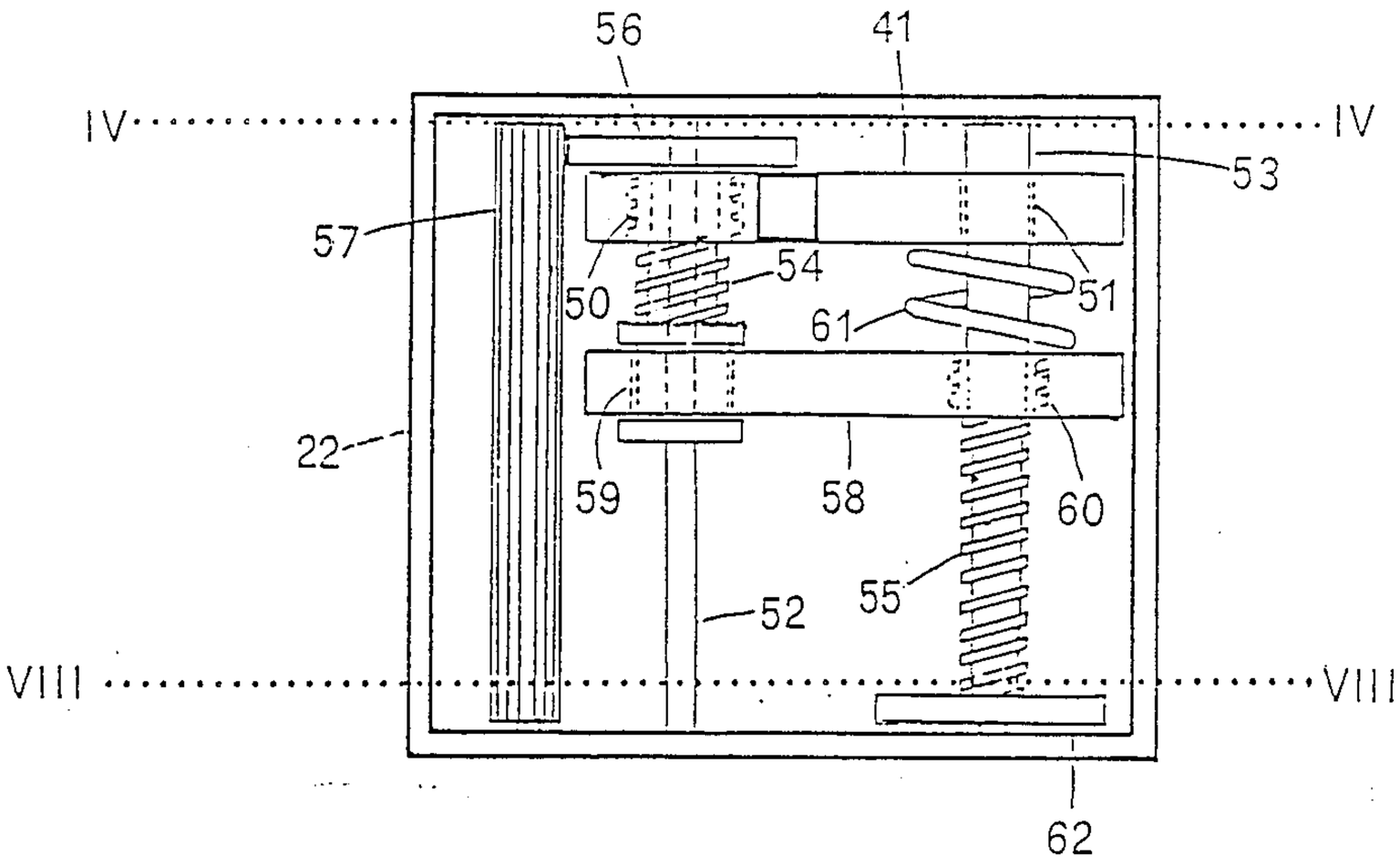
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FIG. 8

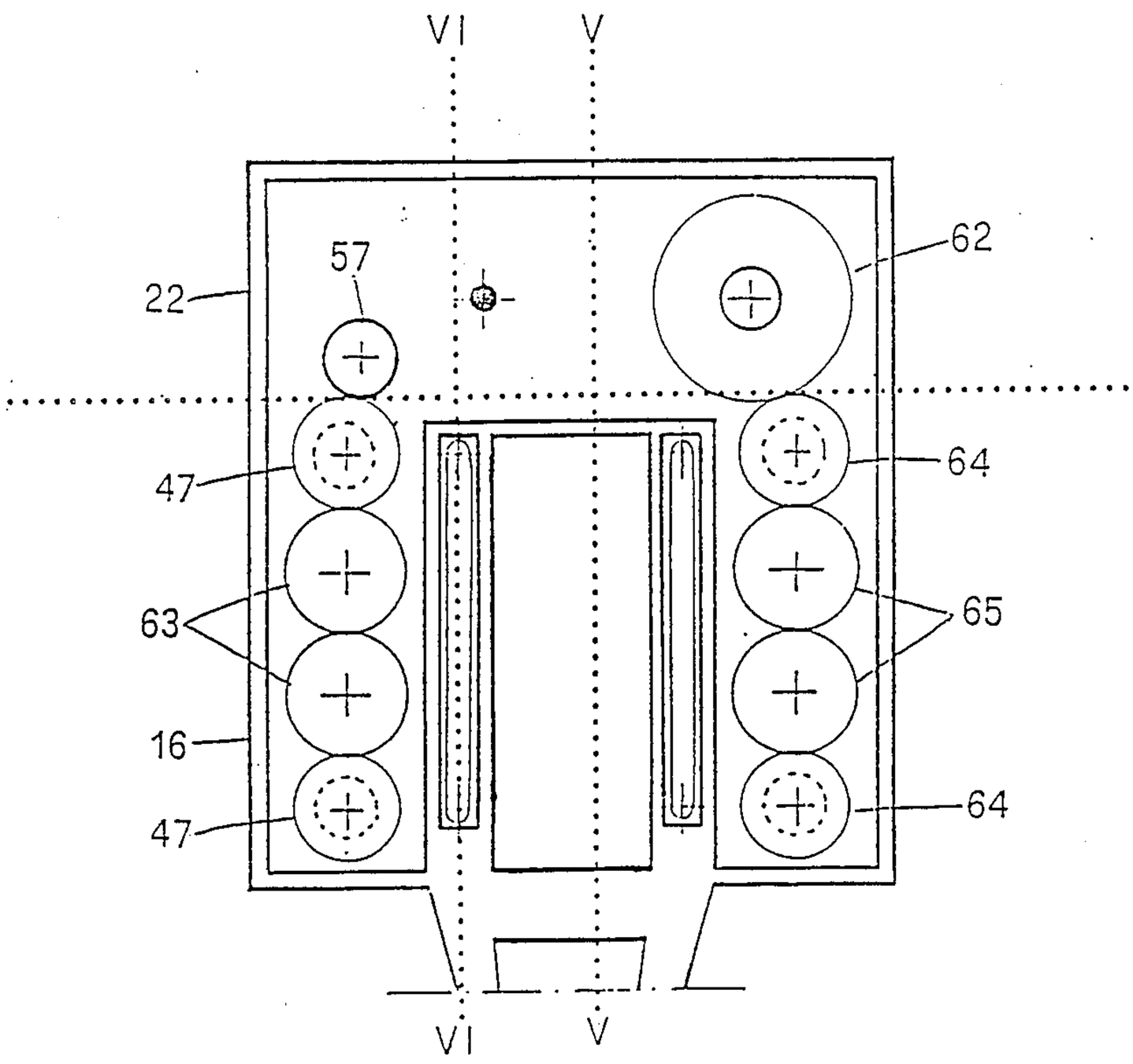
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FIG. 9

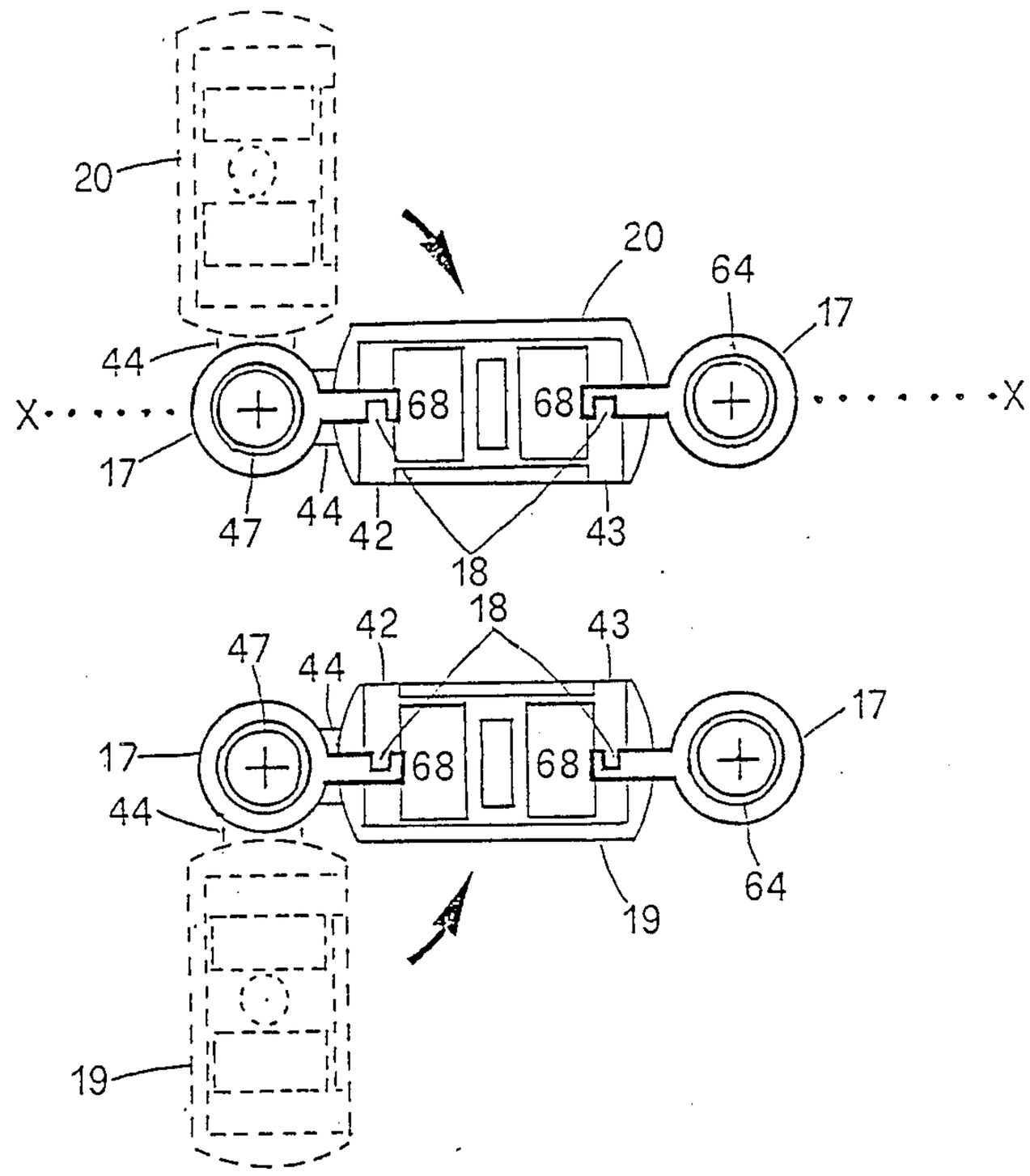
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FIG. 10

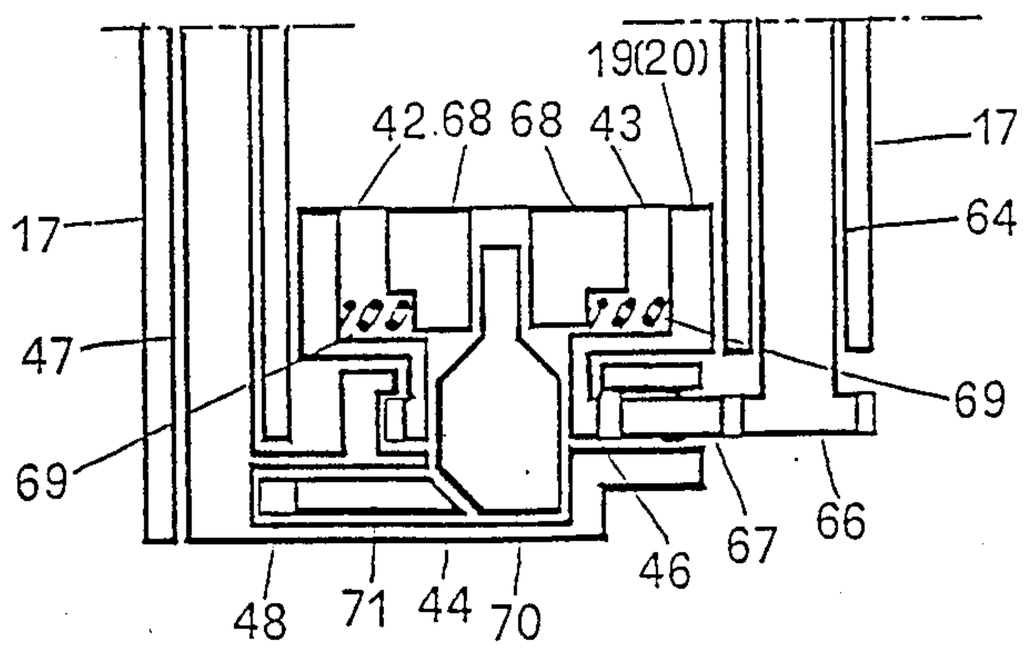
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FIG.11

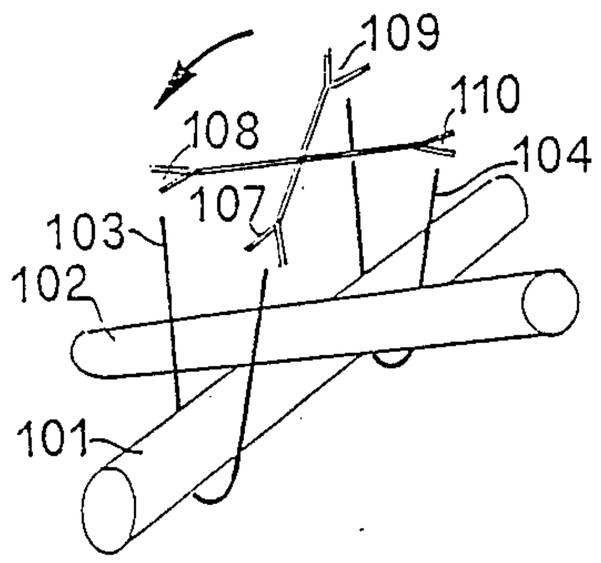


FIG.12

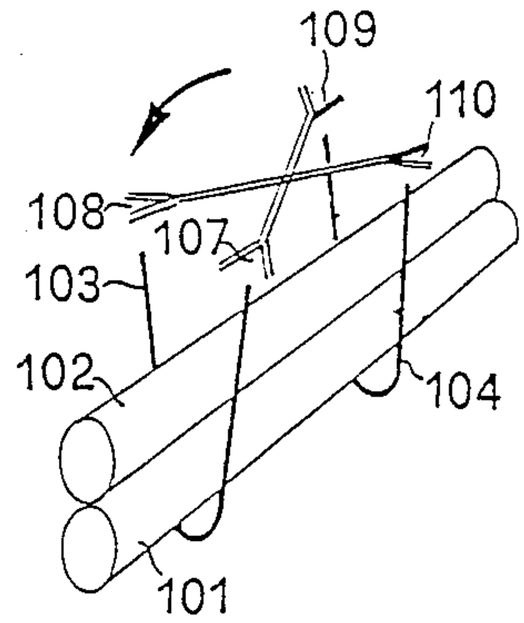


FIG.13

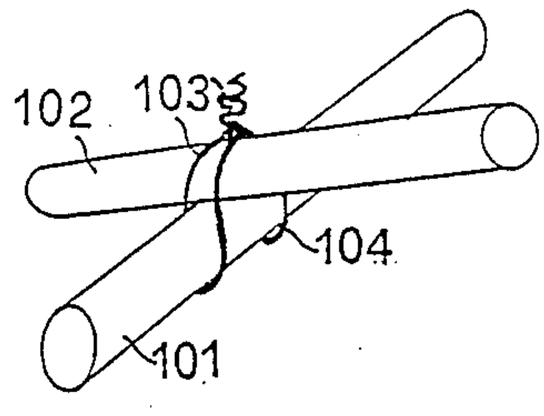
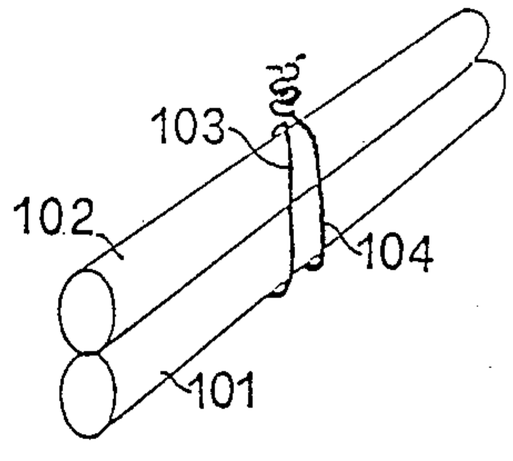


FIG.14



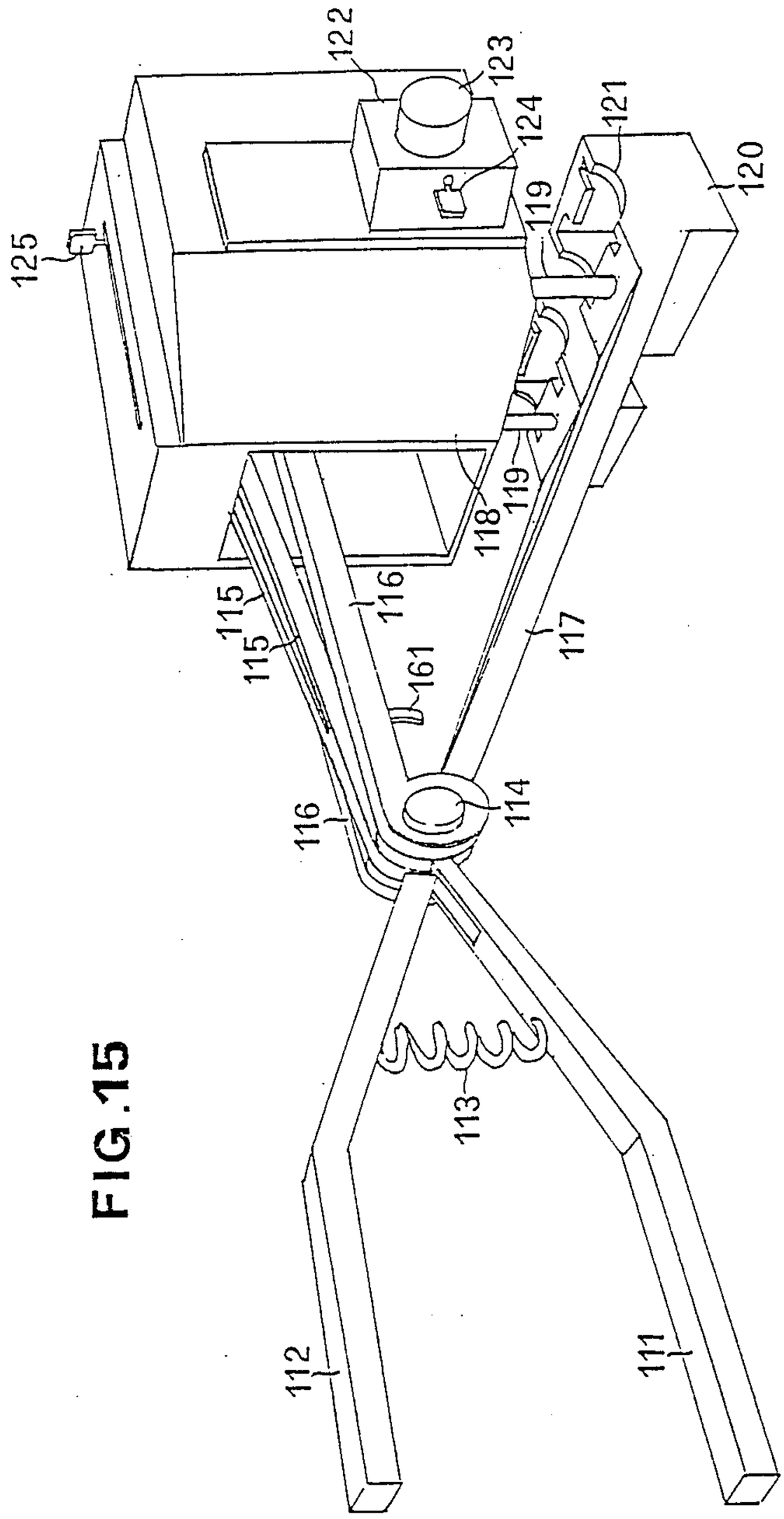

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FIG.15

FIG.16

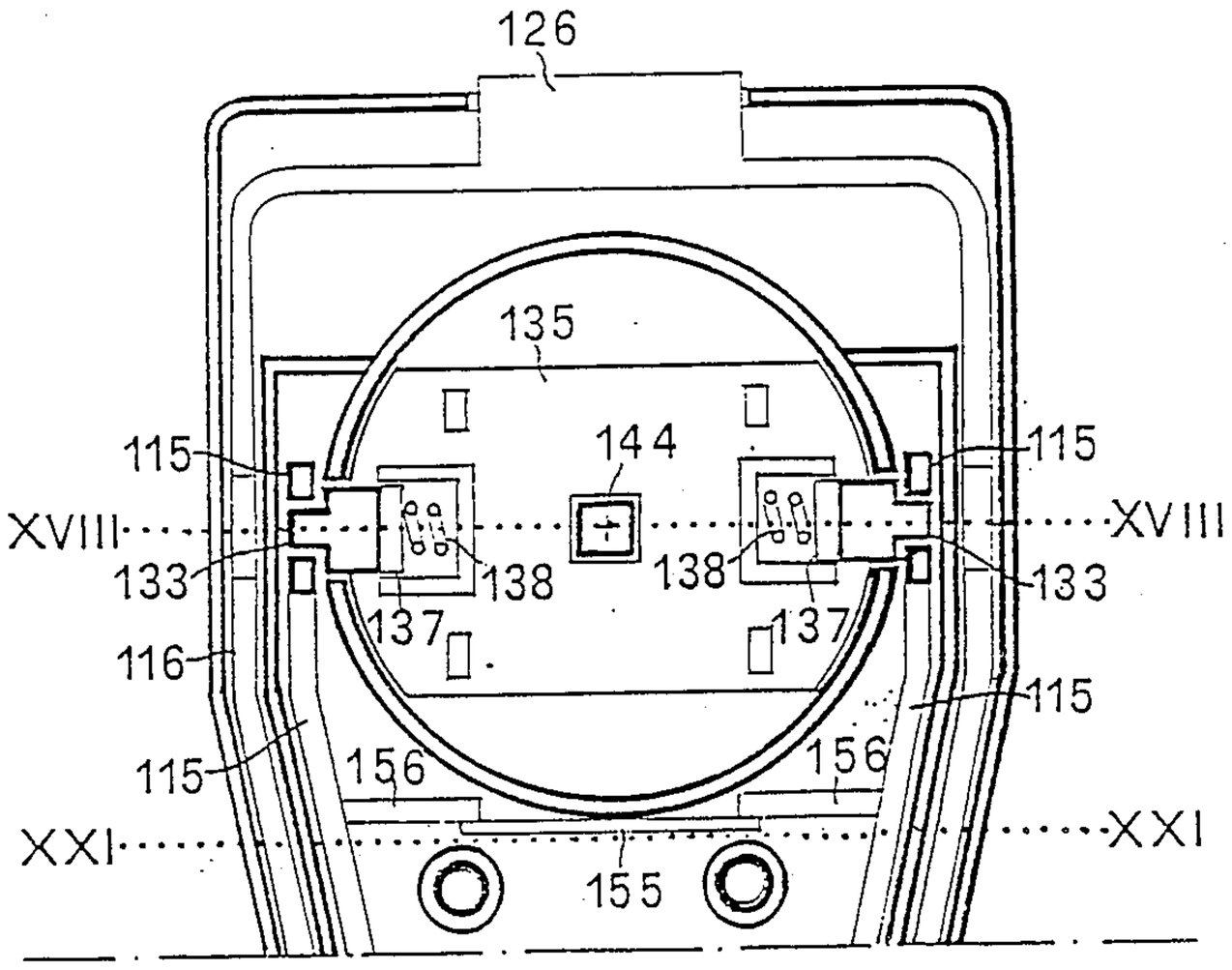
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FIG.17

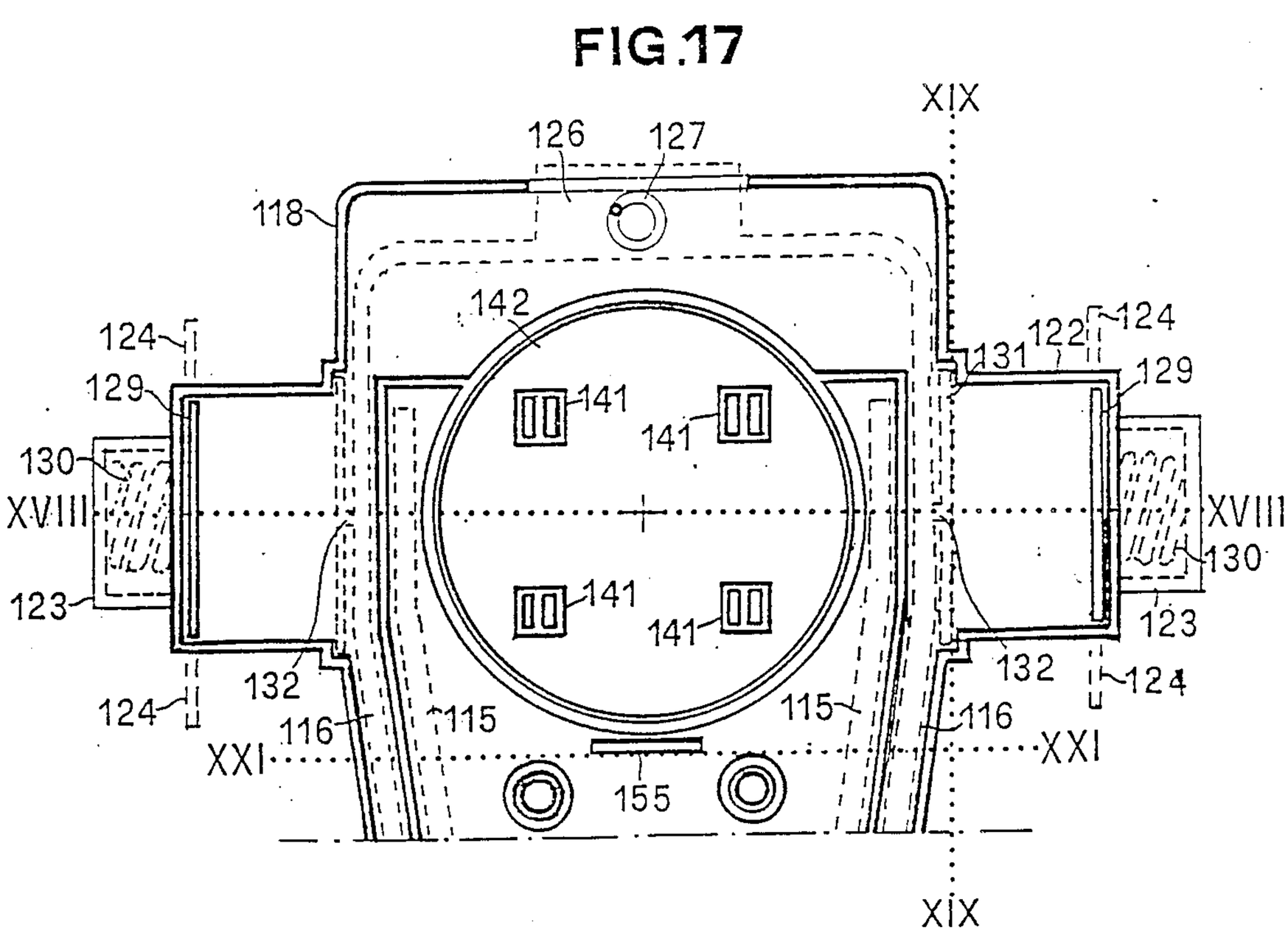
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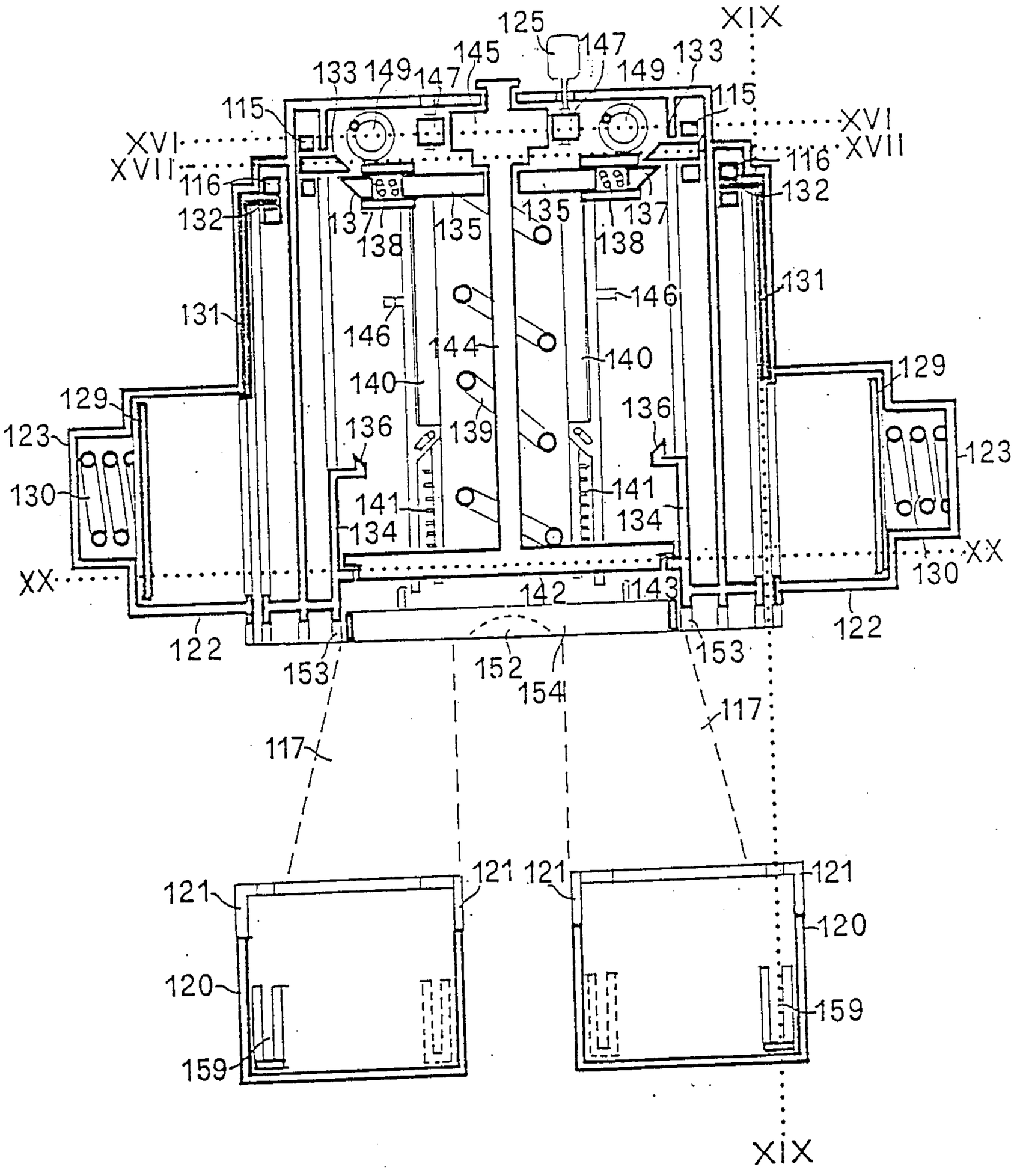
FIG.18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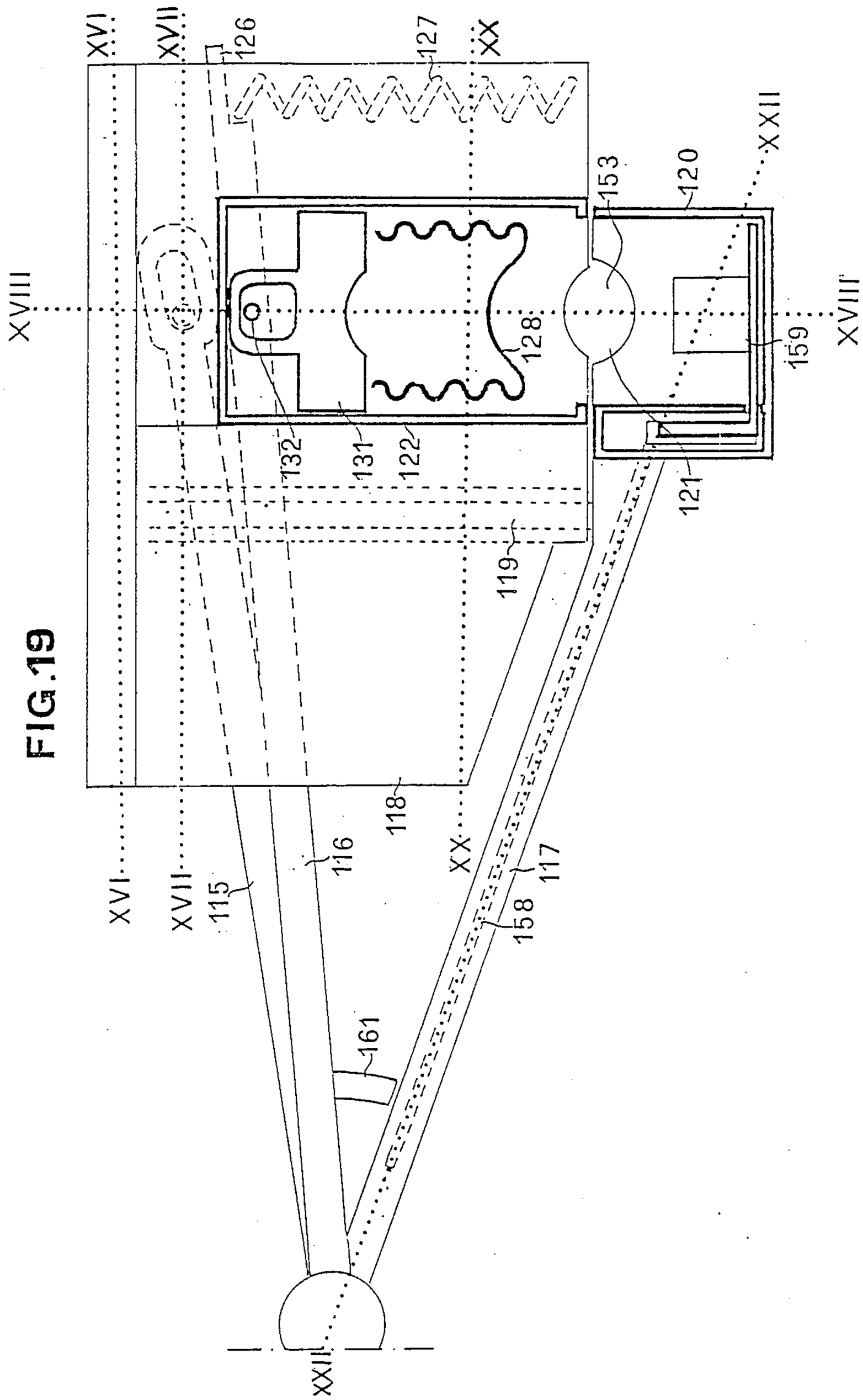
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FIG.19

FIG. 20

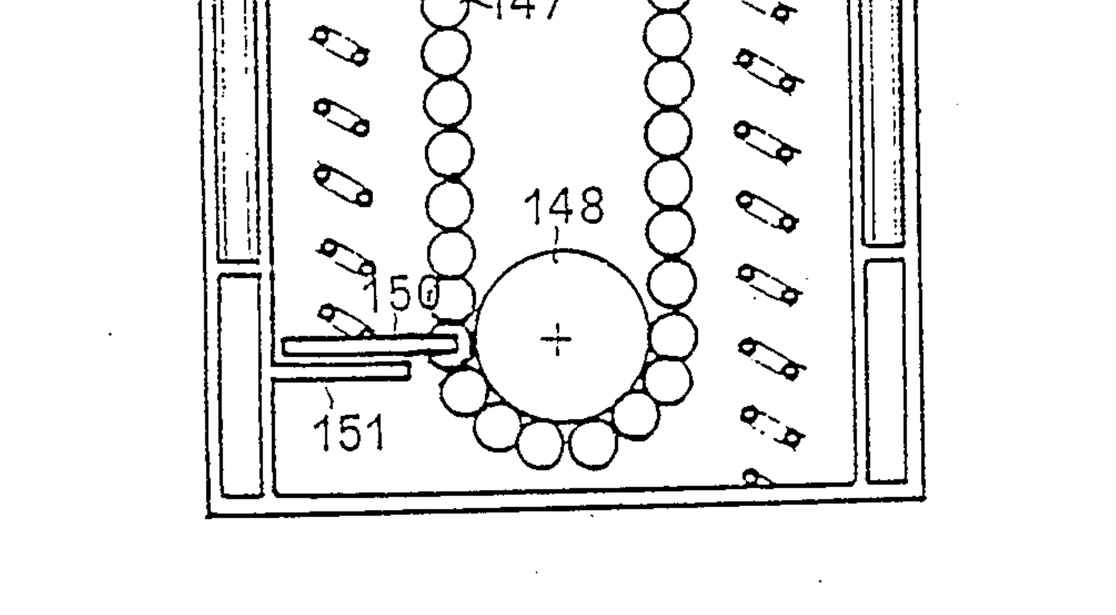


FIG. 21

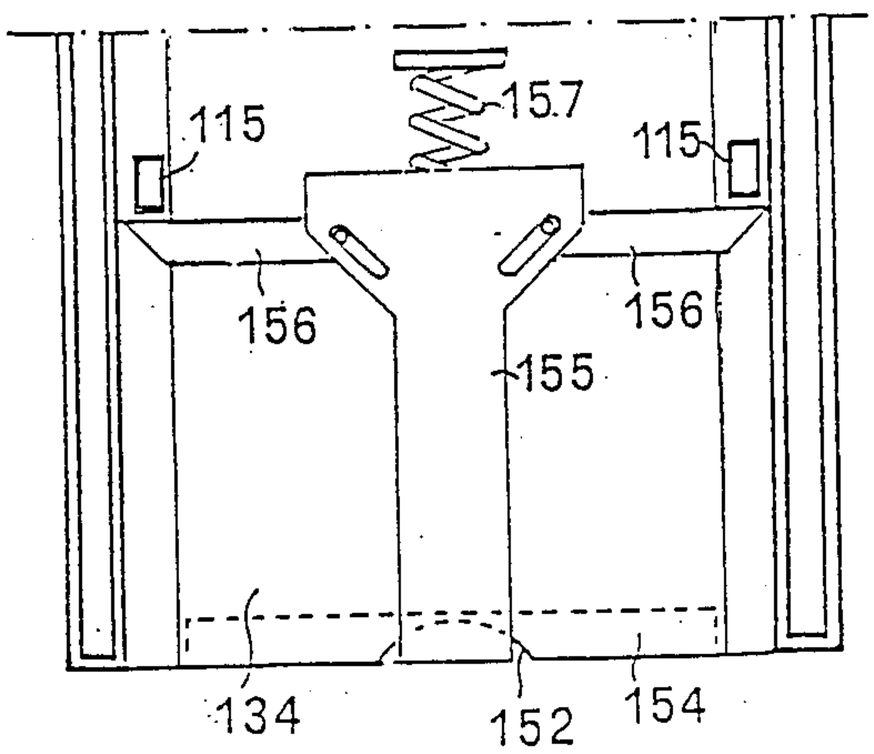
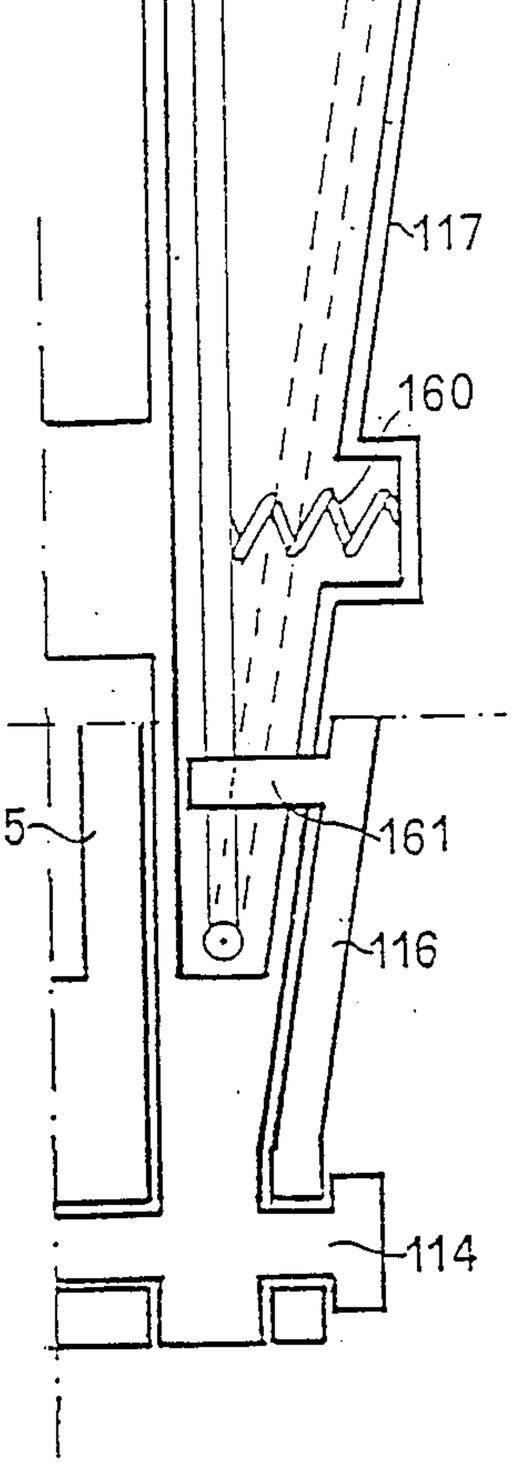


FIG. 22



AUTOMATIC APPARATUS FOR STRAPPING ELONGATED SUPERPOSED BODIES

The present invention relates to an apparatus capable of automatically performing, following a manual or mechanical actuation, the strapping of superposed elongated bodies in either a parallel or axially angled relationship.

More particularly, by the term "strapping of elongated bodies" the binding of reinforcing rods, bars, strips, angle iron, pipes, shafts and the like by means of relatively rigid wire-like elements of any kind of material is intended.

At present, this kind of strapping is performed by the manual winding of one or more pieces of iron wire or cord around the articles of the above mentioned kind and then twisting, with the eventual help of a suitable tool, for instance a pair of pliers or nippers, the ends of said pieces of iron wire or cord.

From the above it clearly derives that, with the method of operation above described, the strapping operation in question is time-consuming and fatiguing for the operator, upon whose personal skill the execution time, the efficiency of the result and the dimensioning with a minimum waste of the pieces of iron wire or cord used, all depend.

In other words, the operation in question performed in this way according to the prior art, may be considered in general entirely uneconomical, both from the point of view of the man-hour costs and that of the cost of the strapping material as a consequence of said unavoidable waste.

The aim of the present invention is to provide an apparatus capable of performing automatically the operation of strapping superposed elongated bodies of the abovementioned kind with an appreciable reduction of execution time as well as of the waste of strapping material, thus avoiding the abovementioned inconveniences deriving from the performance of said strapping operation according to the conventional practice presently in use.

The adoption of the apparatus of the present invention makes it possible to obtain, among other things, the following advantages:

- to ensure continued work with uniform results independent on the skill of the operator and of his physical and mental efficiency;
- to simplify to a maximum the operation;
- to render the work much easier and not at all fatiguing;
- to shorten to a maximum the operational times;
- to adjust automatically the quantity of material used for each strapping operation.

The present invention will be better illustrated hereinafter by the disclosure of preferred embodiments thereof referred to as non limitative examples, with reference to the attached drawings, wherein:

FIG. **1** is a perspective view showing schematically the principle of operation of a first embodiment of the apparatus in question;

FIG. **2** is a perspective view showing schematically the result of the strapping operation performed according to the principle of operation shown in FIG. **1** of the first embodiment of the apparatus in question;

FIG. **3** is a perspective view of the first embodiment of the apparatus in question;

FIG. **4** is a partially sectional view taken along lines IV—IV of FIG. **5**, FIG. **6** and FIG. **7**;

FIG. **5** is a partially sectional view taken along lines V—V of FIG. **4** and of FIG. **8**;

FIG. **6** is a sectional view taken along lines VI—VI of FIG. **4** and of FIG. **8**;

FIG. **7** is a sectional view taken along lines VII—VII of FIG. **4** and of FIG. **8**;

FIG. **8** is a partial sectional view taken along lines VIII—VIII of FIG. **5**, FIG. **6** and FIG. **7**;

FIG. **9** is a sectional view taken along line IX—IX of FIG. **6**;

FIG. **10** is a sectional view taken along line X—X of FIG. **9**;

FIGS. **11** and **12** are perspective views which show schematically the operating principle of a second embodiment of the apparatus in the case of superposed bodies in an axially angulated relationship and in an axially parallel relationship;

FIGS. **13** and **14** are perspective views which show schematically the result of the strapping operation performed according to the operating principle shown in FIG. **1** and in FIG. **2**, wherein the rotatable system of four clamp elements is schematized;

FIG. **15** is a perspective view of the second embodiment of the apparatus in question;

FIG. **16** is a partial sectional view taken along lines XVI—XVI of FIG. **18** and FIG. **19**;

FIG. **17** is a partial sectional view taken along lines XVII—XVII of FIG. **19**;

FIG. **18** is a partial sectional view taken along lines XVIII—XVIII of FIG. **16**, FIG. **17**, FIG. **19**, and FIG. **21**;

FIG. **19** is a partial sectional view taken along lines XIX—XIX of FIG. **17** and FIG. **18**;

FIG. **20** is a partial sectional view taken along line XX—XX of FIG. **18** and FIG. **19**;

FIG. **21** is a partial sectional view taken along line XXI—XXI of FIG. **16** and FIG. **17**; and

FIG. **22** is a partial sectional view taken along line XXII—XXII of FIG. **19**.

With reference to FIGS. **1** and **2**, the principle of operation of a first example of embodiment of the apparatus of the present invention for strapping together two reinforcing rods **1** and **2**, placed in a superposed and crossed relationship is schematically shown therein, entailing the operation of predisposing two strapping elements, with the shape of forks **3** and **4** of a relatively rigid and flexible material, straddling the upper reinforcing rod **1** on opposed edges of the lower reinforcing rod **2**, to engage the corresponding ends of the forks **3** and **4** in respective holes **5** and **6** of two rotatable drums **7**, to rotate said drums **7** in the sense shown with arrows so as to twist the respective ends of the forks **3** and **4**, as shown in FIG. **2**, performing in this way the desired strapping.

Studying FIG. **3**, wherein the first example of embodiment of the apparatus of the invention is shown in an overall view, and premitting that the components shown therein will be referred to in a simplified way, deferring to the prosecution of the present discussion the description of the details relating to the members destined to the operation in the apparatus itself as specifically shown in the following figures, are shown as **8** a movable handle and as **9** a fixed handle between which a helical restoring spring **10** is arranged. The movable handle **8** has one of its ends fixed to a rounded block **11**, rotatable around a pin **12**, capable of rigidly connecting

the first ends of two actuation levers **13** and **14**, which are parallel and spaced from each other, between which a third actuation lever **15** extends having a first end which is also rotatable around the pin **12**. The fixed handle **9**, carrying the pin **12** transversely fastened thereto, has an extension thereof extending beyond the latter integral with the base **16** of the apparatus in question constituted by a box-like body from the lower wall of which four tubular legs **17** normally extend to each of which is externally associated a channel guide **18** and containing internally rotatable shafts connected to gears (to be better defined hereinafter), housed in the box-like base **16** destined to impart the foreseen movements to two drums **19** and **20** placed at the lower end of the respective legs **17** and which are shown in dotted lines in the disengaged position and in solid lines in the operating position.

Over the base **16** a carter **21** is arranged, fastened in front to and in communication with a parallelepipedal box member **22** containing the actuation members (better described hereinafter) which is also fastened to and in communication at the lower side with the box-like base **16**.

Passing now to study in detail the constructional details for the operation of the apparatus of the present invention, reference is made initially to FIG. **4** wherein two containers or loaders are indicated by **23** and **24**, capable of containing a plurality of strapping elements previously shaped and dimensioned, arranged side by side, which hereinafter will be identified as forks, owing to their shape, as is better seen in FIG. **6**, and indicated with **25**, only one of which is shown in each of said containers **23**, **24** for the sake of clarity.

As they are utilized, the forks **25** within each loader **23**, **24** are advanced by means of respective push plates **26**, each one provided with an external knob **27** for the manual displacement to the start position (see also FIG. **3**), under the constant bias of helical springs **28** contained in hollow cylindrical housings **29**, until bringing the innermost spring of each loader **23**, **24** under a respective arc-shaped slider **30** (see also FIG. **6**) fastened to a pin **31** in engagement with a slot **32** (see FIG. **5**) machined longitudinally in one end of a flat rod **33** the other end of which is fastened to toothed sector **34** in engagement with a corresponding toothed sector **35** on the second end of the respective lever **14**, **15**.

As one may notice from FIGS. **4** and **5**, the levers **13** and **14** are connected to each other by means of a tie bar **36** from the ends of which respective bars **37** with a circular section extend, one only of which is shown in FIG. **5**, the free ends of which are connected to each other by means of a second tie rod **38**, shown sectioned in FIG. **5**, the lever **15** intermediate between the levers **13** and **14** being included between said bars **37** and having the second end, wherein a slot **39** is machined (see FIG. **5**) in engagement with a fixed pin **40**, as well as integral with a first movable plate **41**, the function of which will be explained hereinafter, contained in the forward box **22**.

In FIG. **6** a fork **25** may be noted, located under the respective slider **30**, this fork being shown in solid lines in the position at the interior of the respective loader **23** and in dotted lines in the operative position, as a consequence of the downward movement of the slider **30**, straddling the upper reinforcing rod **1**, and with the legs, extending on one side of the lower reinforcing rod **2**, in engagement with the corresponding channel shaped guides **18** associated to a first and a second leg **17** lying on a longitudinal plane of the apparatus, the ends of the arms of the forks **25** extending beyond the lower ends of said channel shaped guides **18** until they arrive at the level of respective recesses **42** and **43** arranged on the drums **19** and **20** within which they will be engaged during the operation, as will be described below in greater detail.

From FIG. **6** it may be also remarked that each of the drums **19**, **20** is rotatably mounted on a respective support **44** by means of a rotation pin **45** on which a toothed wheel **46** is keyed, arranged, as it will be seen hereinafter, to impart to the associated drum **19**, **20** the rotation movement around its axis for the execution of the twisting of the ends of the forks **25** engaged with it. One end of the support **44** is integral with the lower end of respective rotation shafts **47** extending respectively in the interior of the left forward and rear legs **17** as seen in FIG. **3**, up to the interior of the box-shaped base **16**. In each support **44**, finally, a square hole **48** is machined, to which a similarly shaped tooth **49** in the respective leg **17** corresponds, the purpose of which will be clarified hereinafter.

In FIG. **7** is shown the mechanism provided to force drums **19** and **20** to carry out a first rotation through 90° to bring them from the disengaged position to the operative position, respectively shown with dotted lines and solid lines in FIG. **3**, and a second rotation on their own axis to perform the appropriate twisting of the ends of the respective forks, as shown in FIG. **2**.

In the figure in question the first movable plate **41** may be noted, mentioned with reference to FIGS. **4** and **5**, which is mounted by means of a threaded hole **50** and a through hole **51** on respective rotatable shafts **54** and **53** of which the first, constituted by the tubular member, has an external thread corresponding to that of said hole **50** and is mounted coaxially on a fixed shaft **52**, while the second has a smooth upper portion and a thread **55** in the lower part. On the top end of the shaft **54** a toothed wheel **56** is keyed meshing with a pinion **57**. The lower end of the shaft **54** is integral with a stub coaxial with the fixed shaft **52** with which, by means of a through hole **59**, a second movable plate **58** is engaged, which is also provided with a threaded hole **60** in engagement with the thread **55**. Between the plates **41** and **58** a helical spring **61** is interposed on the shaft **53** on the lower end of which a toothed wheel **62** is keyed.

In FIG. **8** is shown the transmission system (contained in the base **16**) of the movements of the mechanism, described with reference to FIG. **7**, to the drums **19**, **20** for the performance of the first and second of said rotations.

In particular the pinion **57** is keyed with the top end, correspondingly splined, of the shaft **47**, to which it transmits the movement, rotatably contained in the left forward leg **17**, as is seen in FIG. **3**, which through the pair of intermediate toothed wheels **63** transmits in its turn the movement to shaft **47** rotatably contained in the left rear leg **17**, as is seen in FIG. **3**, causing the supports **44** (see FIG. **6**) of the drums **19**, **20** to rotate in this way through 90°, in one sense or the other according to the sense of rotation of the pinion **57**, to bring the latter from said disengagement position to said operative position and the converse.

The toothed wheel **62**, in its turn, meshes with the top end, suitably splined, of the shaft **64**, to which it transmits movement, rotatably contained within the right forward leg **17**, as is seen in FIG. **3**, which through the pair of intermediate toothed wheels **65** transmits the

rotation to the shaft **64** rotatably contained in the right rear leg **17**, as is seen in FIG. **3**, in such a manner as to rotate the drums **19** and **20**, which are in said operative position, on their own axes, as will be described hereinafter in greater detail.

In FIG. **9** is shown in greater detail, with respect to FIG. **3**, the rotation through 90° made in the sense of the arrows by the drums **19** and **20** through the related underlying supports **44** to bring them from the disengagement position, shown with dotted lines, to the operative position, shown with solid lines, capable of engaging the respective ends of two forks **25** (not shown), extending beyond the lower ends of the channel shaped guides **18** (see also FIG. **6**), in the respective recesses **42** and **43**, in which they will be locked by means of the clamps **68**, the operation of which will be explained with reference to the following FIG. **10**, for the subsequent twisting in order to complete the strapping in question.

With reference to FIG. **10**, all the schematically shown components of the apparatus in question may be noted more clearly, which operate directly on each of the drums **19**, **20** (and the pertaining supports **44**) for the accomplishment of the preliminary rotation through 90° and the subsequent rotation around their own axis, referred to several times during the present disclosure, as well as the structure and the operation of the abovementioned clamps **68** for the locking of the ends of the forks **25** (not shown) introduced in the recesses **42** and **43** fo the respective drums **19** and **20**.

At the left and right side of the figure in question may be noted the left forward or rear leg **17** and respectively the right forward or rear leg **17**, as seen in FIG. **3**, shaft **47** being rotatably contained in the first and shaft **64** being rotatably contained in the second. The lower end of shaft **47** is connected to the support **44** of drum **19** (**20**) which has already performed the preliminary rotation through 90° from the disengagement position to the operative position. In this latter position, the toothed wheel **66**, provided on the lower end of the shaft **64**, meshes with an intermediate toothed wheel **67** which in its turn meshes with the toothed wheel **46** keyed on the pin **45** for the rotation of the drum **19** (**20**).

With the above described arrangement, the rotation movement of the shaft **64** is transmitted to the drum **19** (**20**) which rotating around its own axis will be able to effect the twisting of the ends of the forks **25** (not shown) engaged in the recesses **42** and **43** in which they are locked by the clamps **68**.

As may be remarked from FIG. **10**, each of the clamps **68** comprises a movable block arranged for displacement, against the action of a respective helical spring **69**, in the direction of the narowing of corresponding recess **42**, **43** until locking the ends of the forks **25** (not shown) therein received. For the abovesaid displacement of the blocks **68** a separator-retractor member **70** is provided which has a top parallelepipedal extension as a stop for the blocks **68** in the open position against the bias of the respective springs **69**, joined underneath to two inclined plane shoulders arranged for the reciprocal spreading apart of the blocks **68**, with a consequent narrowing of the recesses **42**, **43** for the abovementioned purpose, when the member **70** is lifted against the push of a tapered end of a rod **71** which operates on a camming surface created on the corresponding edge at the base of the member **70** itself, the rod **71** being displaced towards the member **70** following the introduction of the tooth **49**, on the legs **17** mentioned with reference to FIG. **6**, within hole **48** in the support **44** of the respective drum **19**, **20**, owing to the fact that the face of the rod **71** opposed to the one in contact with the member **70** is shaped as an inclined plane in a direction perpendicular to the plane of FIG. **10**.

In the operation of the present example of embodiment of the apparatus of the invention as it has been disclosed previously in detail, premitting that the directions of movement of the movable parts will be indicated as seen in the drawings, the handles **8** and **9** are gripped with one hand and the legs **17** are placed straddling the reinforcing rods **1** and **2** in the point of superposition (see FIG. **3**). By squeezing the grasped handles **8** and **9**, the first one will rotate towards the second around the pin **12** with a consequent downward rotation of the levers **13** and **14** which through the coupling of the gear sectors **35** on the second internal ends with the respective gear sectors **34** of the flat rods **33** will cause the latter to rotate downwards, which in their turn entrain in the same direction pins **31**, slidable in the respective slots **32**, (see FIG. **5**) and consequently the sliders **30** integral with them. The lowering of the sliders **30** brings the respective forks **25**, one from each container **23**, **24**, into the position for the performance of the strapping, indicated in dotted lines in FIG. **6**, with the ends protruding beyond the free ends of the channel shaped guides **18** associated to respective pairs of legs **17** up to the level of the recesses **42**, **43** in the drums **19**, **20** in which they will be inserted following the rotation through 90° of the drums **19**, **20** from the disengagement position, shown in dotted lines in FIGS. **3** and **9** and in solid lines in FIG. **6**, to the operative position, shown in solid lines in FIGS. **3** and **9**, and in which they will be locked by means of the blocks (see FIG. **10**) of the clamps **68** displaced in the locking position against the action of the springs **69**, by means of the inclined plane shoulders of the separator-retractor member **70** when this is lifted by the displacement of the respective rods **71** which operate on the camming surfaces of the former when, as already said, each of the teeth **49** is inserted into the corresponding hole **48** (see FIG. **6**). At this moment the manner in which the abovesaid rotation through 90° of the drums **19**, **20** occurs should be detailed, as well as the subsequent rotation of the same around their own axis for the completion of the strapping operation of the reinforcing rods **1** and **2** under consideration.

As stated above, lever **15** is interposed between the levers **13** and **14** and consequently the downward rotation of the latter will cause the rotation in the same sense of the former around the pin **12** by means of the bar **36**, with pin **40** which slides within the slot **39** (see FIG. **5**). On the other hand, as will be remembered, the internal end of the lever **15** is fastened to the first movable plate **41** and consequently the latter will be pulled downwards firstly along the threading on shaft **54**, with which its threaded hole **50** is engaged, and along the smooth upper part of shaft **53**, with which its through hole **51** is engaged, with a consequent compression of the helical spring **61**, and then pulling with it in said movement the second movable plate **58** along the threading **55** on the shaft **53**, with which its threaded hole **60** is engaged, and along the shaft **52** with which its through hole **69** and the related support sleeve are engaged. The movement of the first plate **41** along the threading on shaft **54** will cause the rotation of the latter with the consequent rotation of the toothed wheel **56**

and of the pinion **57** which will rotate through 90° the shaft **47** contained in the interior of the forward left leg **17**, as seen in FIG. **3**, which in turn, by means of the idling wheels **63** (see FIG. **8**), transmits a similar rotation to shaft **47** contained in the interior of the rear left leg **17**, as seen in FIG. **3**, so that the drums **19** and **20**, by means of the respective supports **44** connected to the lower ends of said shafts **47**, will go from said position of disengagement to said operative position. With the drums **19** and **20** in the operative position, the toothed wheel **46** keyed on the rotation pin **45** of each of them (see FIG. **6**) will engage, by means of the idling toothed wheel **67** (see FIG. **10**), the toothed wheel **66** on the lower end of the shaft **64** contained in the respective one between right legs **17**, as seen in FIG. **3**. With the abovementioned arrangement the rotation of the toothed wheel **62**, determined by the downward pull of the second movable plate **58** along the threading **55** on the shaft **53**, (see FIG. **7**), will rotate the shafts **64** through the engagement of one of them (see FIG. **8**) and the transmission of the movement to the other one through the idling toothed wheels **65**, obtaining in this way the rotation of the respective toothed wheels **66** and consequently of the drums **19**, **20** around their own axes as a consequence of the above describe coupling. As a consequance of the above, the ends of the forks **25** engaged and locked in the recesses **42**, **43** of the respective drums **19** and **20** are twisted, as schematically shown in FIG. **2**, obtaining the desired strapping.

In the reversed phase of disengagement of the apparatus in question from the strapped reinforced rods **1** and **2**, the movable plate **41** will be firstly displaced upwards, under the bias of the spring **61**, previously compressed, rotating the toothed wheel **56** the pinion **57** and the shafts **47** in a contrary sense, the latter performing a rotation through 90° will return the drums **19** and **20** to the starting position after the unlocking of the clamps **68** performed as a consequence of the exit of the teeth **49** from holes **48** which will allow the displacement downwards of the separator-retractor member **70** under the action of the springs **69** on the respective blocks **68**. The upwards movement of the second movable plate **58** will then follow, with an idle rotation of the shafts **64**. When the return stroke of the plates **41** and **58** is completed, sliders **30** will also resume their starting positions following the reverse movement of levers **13** and **14** as a consequence of the restoring spring **10** between handles **8** and **9**, which pushes apart the second one from the first one as a consequence of the release of the initial squeeze, while in the meantime the push plates **26** in the loaders **23** and **24** will have brought another pair of forks **25** into the position of engagement with the sliders **30**. When the forks **25** are finished, the push plates **26** will be displaced to the initial end of stroke, i.e. the one shown in FIG. **4**, by means of the respective knobs **27** and the loaders **23** and **24** will be filled again

With reference to FIGS. **11** to **14** the principle of operation of a second example of embodiment of the apparatus of the present invention for strapping together two reinforcing rods **101** and **102** placed in a superposed relationship either crossed or parallel is schematically shown, entailing the operations of: predisposing two strapping elements, under the form of forks **103** and **104** made of relatively rigid and flexible material, straddling under the lower reinforcing rod **101** on opposed ends of the upper reinforcing rod **102**; to engage the ends of the forks **103** and **104** in respective clamps **107**, **108**, **109** and **110** of a rotatable device; to rotate said device in the sense indicated by the arrow in order to twist all the ends of the forks **103** and **104** together, as is shown in FIGS. **13** and **14**, constituting in this way the desired strapping.

Passing now to consider FIG. **15** wherein an overall view of a second example of embodiment of the apparatus is shown, and premitting that the components illustrated therein will be referred to without too many details deferring to the prosecution of the present discussion the description of the details relating the members arranged for the operation of the apparatus itself as specifically shown in the following figures, a movable handle is indicated by **111** and a fixed handle by **112**, between which a helical return spring **113** is interposed. The movable handle **111** is rotatable around a pin **114** and is integral with a pair of levers **115**, which actuate with their ends a mechanism which will be disclosed in the following, contained in a carter **118**, which is displaced vertically by said pair of levers **15**. The fixed handle **112** is integral with the pin **114** and with a pair of extensions **117** extending beyond the pin **114** and integral with two box-like bodies **120**, from the upper face of which two pins **119**, one for each box-like body, extend perpendicularly, which operate as a guide to the carter **118** in its vertical movements. A further pair of levers **116** is hinged on the pin **114**, around which they can rotate freely, the opposed ends of said two levers **116** converging, in the interior of the carter **118**, into a small plate **126** (represented in FIGS. **16**, **17** and **19**), which is held raised by a helical spring **127**. At the sides of the carter, are applied, one for each side, two containers **122**, which will be disclosed in greater detail below.

Passing now to consider in detail the constructional details for the operation of the apparatus of the present example of embodiment, reference is made first of all to FIG. **17** and to FIG. **18**, wherein two containers are indicated by **122**, arranged to house a plurality of strapping elements previously proportioned and shaped, as better seen in FIG. **19**, and indicated by **128**, placed side by side, and identified in the following as forks.

As they are utilized, the forks **128** within each container **122** are advanced by means of respective push plates **129**, each one provided with external knobs **124** for the manual displacement to the start position (see also FIG. **15**) under the constant bias of helical springs **130** contained in hollow cylindrical housings **123**, until bringing the innermost fork of each container **122** under a respective slider **131** (see also FIG. **19**) activated, by engagement with a slot, by a pin **132** integral with one of the two levers **116**. Said pair of levers **116** is lowered by exerting manual pressure on the small plate **126** which compresses the spring **127**, which returns the small plate **126** to the starting position when the manual pressure ceases.

It may be appreciated from FIG. **16** and from FIG. **18** that the ends of the pair of levers **115** integral with the movable handle **111** are engaged with two pawls **133** which, under the push of the pair of levers **115**, slide vertically each within a groove machined in a cylinder **134** up to an abutment **136** represented in FIG. **18**; in their displacement in a vertical sense said pawls **133** push a plate **135** downwards until said abutments **136** have displaced the sliding blocks **137** (see FIGS. **16** and **18**) compressing the springs **138**. As a consequence of the displacement of said sliding blocks **137**, said plate **135** is disengaged from said pawls **133** and, under the bias of the helical spring **139** (see FIG. **18**), it returns to

the starting position. Four vertical segments **140** are integral at their upper end with the plate **135**, and each of them is provided with a clamp **141** at its lower end, and they pass through a circular drum **142**, supported by a ridge **143** in said cylinder **134** and capable of rotating under the action of a square-section shaft **144** which passes throuh said plate **135** and is integral at its upper end with a toothed wheel **145**. In its rotation the drum **142** forces into rotational movement the four vertical segments **140** provided with clamps **141** as well as said plate **135**. Immediately before plate **135** disengages itself from the pawls **133** the protruding dogs **146**, with which the sements **140** are provided, strike against the upper plane of the drum **142**, thus causing the locking of the clamps **141**.

The toothed wheel **145** engages with a chain transmission **147** (see also FIG. **20**) which is supported by two independent toothed wheels **148**. Two helical springs **149** compress two ridges **150** of the chain **147** against a corresponding number of ridges **151** fastened to the carter **118**. By means of a manual displacement of knob **125** integral with one of the ridges **150** of the chain **147**, the ridge **150** is brought to lock itself to a blocking device, not shown; located in the position of maximum compression of the helical springs **149**; the unlocking of the ridge **150** is controlled by plate **135**, which operates on said blocking device when the spring **139** brings back said plate to the starting position at maximum height after the abutments **136** have disengaged it from the pawls **133**.

On the lower edge of the cylinder **134**, in the direction of the longitudinal axis of the apparatus, two rests **152** are cut, one of which is shown in dotted lines in FIG. **18** and, in the direction of the transversal axis, two similar rests **153** are cut, which in the same FIG. **18** are seen in sectional view; a circular strap **154** adherent to the internal surface of the cylinder **134** and which can be slid upwards is connected to a small vetical plate **155** (see FIGS. **16**, **17** and **21**) which controls the horizontal translation of two tie-rods **156**, which are kept separated in the rest position by the pressure of the helical spring **157**, preventing the downward displacement of the two levers **115**.

FIG. **22**, which is a partial sectional view taken along the line XXII—XXII of FIG. **19**, shows a lever **158** which, in the interior of each of the two extensions **117**, displaces a support **159** contained in each of the two box-shaped bodies **120** in the direction transversal to the apparatus **1**; the lever **158**, which in the rest position is kept compressed against the internal wall of the extension **117** by the action of a helical spring **160**, may be displaced towards the exterior by a hook **161** applied to the lever **116**.

For the operation of the present example of embodiment of the apparatus of the invention as disclosed previously in detail, the operations are performed in two steps, which may be respectively defined: loading phase and working phase.

In the first phase, the loading one, the handles **111** and **112** are grasped with one hand and, squeezing them, the pair of levers **115**, prevented from lowering with respect to the cylinder **134** by the pair of tierods **156**, compels the whole carter **118**, integral with the cylinder **134**, to approach the box-like bodies **120** in a direction perpendicular to the upper face of said box-like bodies **120** because they are guided by the pins **119**. When the approach has been completed, and consequently in the position represented in FIG. **19**, with a finger of the other hand pressure is exerted on the small plate **126** with a consequent lowering of the pair of levers **116**; in the first portion of said lowering, while the pin **132** of each of the two levers **116** runs from top to bottom of the slot in the respective slider **131**, the corresponding hook **161** integral with the lever **116** displaces towards the exterior the lever **158** contained in the respective extension **117**, and the lever **158** in its turn displaces towards the exterior the support **159**; consequently in the second portion of said lowering of each of the levers **116** the pin **132** displaces the slider **131** downwards, which in its turn pushes downwards the first of the forks **128** contained in the container **122**, until bringing it to the support **159** which in the meantime will be located in the box-like body **120** in the position represented by the dotted lines in FIG. **18**, and which corresponds to the vertical with respect to the slider **131**. On ceasing to exert pressure on the small plate **126**, the helical spring **127** returns to the starting position, and consequently each one of the two pins **132** brings back upwards each of the two sliders **131**, and each of the two levers **158**, disengaged from the respective hook **161** brings the respective support **159** back to the interior in the rest position, which is located on the vertical of a pair of the four segments **140** provided with the clamps **141**. The return of the sliders **131** to their rest position upwards allows each of the helical springs **130** to push another fork contained in each of the two containers **122** under the slider **131**. Having stopped the pressure on the small plate **126** with a finger of the hand which does not keep handles **111** and **112** closed, with said hand the knob **125** connected to the chain **147** is pulled from the rest position up to the locking position with the blocking device, in this way putting the two helical springs **149** under the maximum compression.

At this moment, by releasing the force on the two handles **111** and **112**, the helical spring **113** separates the pair of levers **115** and also the extensions **117**, with a consequent moving away of the carter **118** from the pair of box-like bodies **120** up to the initial rest position. At this moment the first phase, identified as the loading phase, in concluded.

The second phase of the operation, the so-called working phase, begins placing the two box-like bodies **120** under the lower elongated element which is located in a transversal direction to the apparatus, taking care that each of the two box-like bodies **120** is placed respectively on one side and the other of the upper elongated memeber, if said two elongated bodies which are to be strapped together are superposed in an axially angulated relationship. Then with one hand the knobs **111** and **112** are squeezed, so that the pair of levers **115**, prevented by the pair of tie-rods **156** from lowering with respect to the cylinder **134**, compels the whole carter **118** to approach the pair of box-like bodies **120**, until said upper elongated body contacts the lower edge of the circular strap **154** in correspondence with the pair of rests **152** if the upper elongated body is in an axially angulated relationship with respect to the lower elongated body, or in correspondence with the pair o rests **153** if the upper elongated body is axially parallel to the lower elongated body; in both cases the pressure which the upper elongated body exerts on the lower edge of the circular strap **59** displaces the small vertical plates **55** upwards, which in its turn causes the horizontal translation of the two tie-rods **156**, with a consequent unlocking of the pair of levers **115**. By continuing to squeeze the handles **111** and **112** the pair of levers **115**,

free to move with respect to the cylinder **134** which has stopped approaching, together with the carter **118** with which it is integral, the pair of box-like bodies **20** because it is prevented from so doing by said elongated members interposed to be strapped together, pushes the pair of pawls **133** downwards, which in their turn push downwards the plate **135** and with this latter the four vertical segments **140** each provided with a clamp **141** at its lower end. The four vertical segments **140**, passing through the circular drum **142**, introduce the clamps **141** into the underlying box-like bodies **120**, in pairs in correspondence with the ends of said pair of supports **159**, each of which is loaded with a fork **128** placed there in the previous loading phase. When the dogs **146** protruding from the vertical segments **140** strike against the upper face of the circular drum **142**, said clamps **141** close grasping and locking the two pairs of legs of the two forks **128**, at a greater or lesser distance from the ends according to whether said clamps **141** are more or less introduced within the box-like bodies **120**, and the greater or lesser introduction of the clamps **141** into said box-like bodies **120** depends upon the sum of the thicknesses of said two elongated bodies to be strapped, said sum of thicknesses maintaining more or less separated from each other the carter **118** and the box-like bodies **120**.

Almost at the same time as the locking of the clamps **141**, the pawls **133** reach the abutments **136**, which cause, with the displacement of the sliding blocks **137**, the disengagement of the plate **135**, which under the action of the helical spring **139** is pushed upwards along with the vertical segments **140** with the pertaining clamps **141** with which they are provided. The legs of the two forks **128**, clamped in the clamps **141**, are drawn as a consequence of the upwards translation of their ends, which are brought up to within the circular drum **142**, while the transversal portions of the forks **128** are held under said lower elongated member to be strapped.

At the end of its upwards stroke, the plate **133** operates on the blocking device, not shown, of the ridge **150** fastened to the transmission chain **147**, causing it to unlock and allowing the two helical springs **149** to exert their pressure on the ridges **150**, which cause the chain **147** to run around the independent toothed wheels **148**. By running, the transmission chain **147** causes the rotatin of the toothed wheel **145** which, by means of the shaft **144**, transmits its rotational motion to the circular drum **142**, and also to the group of four clamps **141** which clamp the ends of said pair of forks **128**. As a consequence of the above, the ends of the two forks **128**, engaged and locked by said clamps **141** in rotational motion, are all twisted together, as is schematically shown in FIGS. **13** and **14**, obtaining thus the desired strapping.

Regarding what has been said before with reference to the distance from the ends of the forks **128** on which the clamps **141** are clamped, it should be noted that said distance may vary as a function of the sum of the thicknesses of the elongated bodies to be strapped and it results therefrom that the length of the portion of fork available to perform the desired strapping is automatically determined by said sum of thicknesses and consequently the number of turns necessary to perform the desired twisting of the ends is constant and independent from the thickness of the members to be strapped. Said number of turns is impressed on the toothed wheel **145** by a complete stroke of the transmission chain **147** from the position of maximum compression of the helical springs **149** up to the impact of the ridges **150** with the ridges **151** fastened to the carter **118**. At the end of said stroke, a pawl **162** (see FIG. **20**), with which the transmission chain **147** is provided, compresses a small lever, not shown, on the upper face of the plate **135**, and said small lever actuates the opening of the clamps **141**, freeing the twisted ends of the forks.

By releasing the grasp of the hand that kept closed the handles **111** and **112**, the helical spring **113** brings the pair of levers **115** to the starting position and consequently moves the carter **118** away from the pair of box-like bodies **120**.

In this way the second phase of the operation, defined working phase, is also concluded.

When the forks **128** contained in the containers **122** are exausted, the push plates **129** are displaced to the end of the initial stroke, i.e. in the position shown in FIG. **17**, by means of the knobs **124** and the containers **122** are filled again.

It should be remarked that the experts in the field may make numerous modifications to the examples of embodiments of the present invention, as above disclosed in detail, and said modifications and variations may regard the shape, arrangement, and means of actuation of the various components, all these falling within the spirit and scope of the invention itself.

Consequently the present invention is not limited to the disclosed examples of embodiments, but encompasses any changes and/or modifications of the same.

I claim:

1. An automatic apparatus for the strapping of elongated superposed bodies, comprising: at least one container wherein several, relatively rigid and previously proportioned and shaped strapping wire-like elements are placed side by side; pushing means in said at least one container, capable of bringing each of said wire-like elements in succession at respective entrainment means, capable of carrying in a guided way, at each stroke, two of said wire-like elements in a straddling position on the upper of said superposed elongated bodies, each along opposite sides of the lower one; two drums associated to first and second means which impart to each of them respectively a first rotation from a disengaged position to an operating position and a second rotation around their axis when they are in said operating position, each of said drums being provided with two housings in which, following the execution of said first rotation, the respective ends of said two wire-like elements in said straddling position on said superposed elongated bodies to be strapped are received and locked, by means of clamp means, in such manner that the subsequent execution of said second rotation of said drums provides the twisting in pairs of said ends of said wire-like elements performing the desired strapping; means to bring back to their respective starting positions movable components consisting of said pushing means, said entrainment means, said drums and said clamp means.

2. An apparatus according to claim **1**, wherein said wire-like strapping elements are fork shaped.

3. An apparatus according to claim **1**, wherein said pushing means is, in respect of said at least one container, a plate slidable under the action of at least one spring capable of making said wire-like strapping elements placed side by saide advance until bringing each of them in succession under said entrainment means as they are used for the execution of strappings, said plate being provided with grasping knobs to bring it to the start position in order to allow the refilling of said at

least one container following the utilization of all said wire-like elements located therein.

4. An apparatus according to claim 1, wherein said entrainment means comprise a slider for said at least one container associated to lever systems connected to manual or motor actuating means capable of displacing it in a direction such as to bring, by pushing upon them, respective wire-like strapping elements in said straddling position on said superposed elongated bodies to be strapped.

5. An apparatus according to claim 4, wherein said drums are rotatably mounted by means of rotation pins on respective supports fastened to the lower end of a first and a second shaft, respectively, rotatably contained at the interior of a first and a second tubular leg extending perpendicularly from the base of said apparatus.

6. An apparatus according to claim 5, wherein said first means for imparting to said drums said first rotation comprise first gears connected to manual or motor actuating means capable of rotating said first and second shafts fastened to the supports of respective drums through an angle such as to bring these latter from a disengaged position to an operative position.

7. An apparatus according to claim 6, wherein said second means for imparting to said drums said second rotation comprise second gears connected to manual or motor actuating means capable of rotating a third and fourth shaft rotatably contained in a third and fourth tubular leg extending perpendicularly from the base of said apparatus, the lower ends of said third and fourth shaft being connected by means of gears to said rotation pins of respective drums in said operating position.

8. An apparatus according to claim 7, wherein said means for bringing back said movable components to their respective starting positions comprise springs previously compressed during the active phase of said apparatus, the release of which, at the end of the strapping operation, causes the movement in a contrary sense of said system of levers and of said first and second gears.

9. An apparatus according to claim 1, wherein said clamp means for locking respective ends of said wire-like strapping elements within housings in said drums comprise blocks movable by means of cam devices in the narrowing direction of the respective ones among said housings against the bias of spring devices, said cam devices being actuated following the actuation of said first rotation of said drums.

10. An automatic apparatus for the strapping of superposed elongated bodies, comprising: at least one container wherein several wire-like strapping elements are placed, which are relatively rigid and previously proportioned and shaped; pushing means in said at least one container capable of bringing in succession each of said wire-like elements at respective entrainment means arranged to carry in a guided way at each stroke two of said wirelike elements in a straddling position under the lower of said superposed elongated bodies, flanking along opposed edges the upper one of said superposed elongated bodies; four locking devices, suitable for grasping and locking the two ends of each of said two wire-like elements; means coupled to said locking devices to impose a suitable number of rotations on them in order to twist said ends of said wire-like elements together, thus performing the desired strapping; means to bring back to the respective starting positions movable components consisting of said pushing means, said entrainment means, said locking devices and said means coupled to the locking devices.

11. An apparatus according to claim 10, wherein said strapping wire-like elements are fork shaped and are specifically shaped to be locked at a variable distance from the end of their ends.

12. An apparatus according to claim 10, wherein said pushing means comprise for said at least one container a plate slidable under the bias of at least one spring capable of advancing said side by side wire-like strapping elements until bringing each of them in succession under said entrainment means as they are gradually utilized to perform strappings, said plate being provided with a strapping knob for bringing it back into the starting position in order to allow the re-loading of said at least one container following the utilization of all said wire-like elements contained therein.

13. An apparatus according to claim 10, wherein said entrainment means comprise a slider for said at least one container associated to lever systems connected to manual or motor actuation means capable of displacing it in a direction, pushing on it, such as to bring respective wire-like strapping elements into said position to straddle said superposed elongated bodies to be strapped.

14. Apparatus according to claim 13, wherein said means for bringing back said movable components comprise springs previously compressed during the active phase of said apparatus, the release of which, at the end of the strapping operation, causes the movement in a contrary sense of said system of levers and of said locking devices.

15. An apparatus according to claim 10, wherein said locking devices are capable of locking the ends of said wire-like elements at a distance variable from their ends.

16. An apparatus according to claim 10, wherein said locking devices consist of clamps.

17. Apparatus according to claim 10, wherein said means coupled to said locking devices comprise a supporting frame rotatable around its axis capable of rotating under the bias of spring devices.

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